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water enveloped in oil boiled at  $180^{\circ}$ , and the different temperatures at which steam condensed in different oils (in my experiments) would seem to indicate, must be determined by further and more exhaustive research.

UNIVERSITY OF KANSAS, November 26, 1884.

## STATISTICS ON COLOR-BLINDNESS IN THE UNIVERSITY OF KANSAS.

EDWARD L. NICHOLS, PH. D.

[Abstract.]

During the past two years I have tested the members of my classes in physics for color-blindness with the Holmgren worsteds. The primary object in these tests was the practical illustration of this interesting subject in the class-room, but the statistics thus collected have some features which may be of more general interest.

The most noteworthy of these is the unusual prevalence of "incomplete" green-blindness among our students. From the far more extended series of tests already made in Europe,\* and elsewhere in this country,† it has been ascertained: that among men about 4 per cent. are completely color-blind; that "red" and "green" blindness are about equally prevalent; and that with very few exceptions women are not color-blind.

The results of my tests were in accordance with those made elsewhere, so far as the above-mentioned particulars are concerned. Of 137 young men subjected to the Holmgren test, five were found to be completely red-blind and four completely green-blind. Of 93 young women, one was completely red-blind. The percentage of those completely color-blind, (6.56 per cent for males,) while above the average, is not in excess of the percentages frequently obtained by other experimenters. (Dr. Feris, for instance, found in testing 501 French sailors that 8.18 per cent. of them were color-blind. Dr. Dor, who tested 611 women in Breslau, found 0.82 per cent. of them to be color-blind.) The number of cases in which the perception of green was notably deficient—in other words, the amount of incomplete green-blindness—was, however, surprisingly large. Besides the four persons classed as completely green-blind, no less than eighteen were found to be incompletely green-blind; so that, including the former, more than 16 per cent. of all the males tested were pronouncedly green-blind. Of the usually more prevalent type, (red-blindness,) but four cases were detected. The total amount of red-blindness was therefore less than 6 per cent. Among the female students, on the other hand, but two cases of green-blindness were found, and in both the deficiency was very slight; while four cases of incomplete red-blindness were recorded.

Even this great excess of green-blindness over the other common variety is not unprecedented. Dr. Krohn, who tested 1,200 railroad employes in Finland, found the ratio of green-blindness to red-blindness to be even larger—*i. e.*, 25: 4. More commonly, however, the latter is the prevailing type; to the extent in Favre's tests upon French railways, for instance, of 13: 1.

The great differences exhibited in color-blind tests, in different parts of the world, are doubtless to a considerable extent due to the different methods pursued, and in the earlier investigations, to the very imperfect knowledge of the subject possessed by those

\*For an account of the principal European investigations prior to 1877, see F. Holmgren; *De la Cécité des Couleurs dans ses rapports avec les Chemins-de-fer et la Marine*, Stockholm, 1877. (Translated in Smithsonian Reports for 1877.)

†See B. Joy Jefferies' work (Color-blindness and its Detection, Boston).

who first began to gather statistics upon it.\* They probably depend also upon differences in the color sense of the classes of individuals tested, which if properly followed up, would lead to much needed knowledge of the causes of color-blindness, and of the laws which govern it. In some recent experiments upon a closely-allied topic—the sensitiveness of the eye to colors of a low degree of saturation †—I discovered among fifty-four of the young men and women, who kindly aided me in that investigation, and who were also included in the color-blind tests, the following almost universal peculiarity of color-perception, which is probably closely related to this prevalence of green-blindness. This peculiarity consists of a marked lack of sensitiveness to the presence of *green* when mixed with large quantities of white. It was found, for instance, that on the average, these observers could detect the presence of 25.2 parts of red lead when mixed with 100,000,000 parts of white, 23.9 parts of chrome yellow, and 125.5 parts of ultra marine, under the same circumstances; whereas 864.3 parts of chrome green in 100,000,000 were necessary to the detection of the pigment.

In describing those experiments, I ventured the suggestion that the difference is due to a blunting of the nerves, the function of which it is to carry the perception of green to the brain, by continual exposure to the hues of foliage, etc. That temporary incomplete color-blindness may be induced at will by wearing spectacles of a tint that overtaxes certain sets of nerves, is well known. May not life-long exposure to the prevailing green of the landscape, generation after generation, well be supposed to produce permanent incomplete green-blindness?

## THE WATER OF THE FORT SCOTT ARTESIAN WELL.

BY E. H. S. BAILEY AND E. W. WALTER.

Several months ago our attention was called to the new artesian well which had been bored at Fort Scott, in this State. Through the kindness of Mr. E. F. Ware, the secretary of the Artesian Well Company, we received samples of the water, with details of the conformation of the strata through which the boring passed. The original idea was to sink a gas well; little gas however has been noticed, but a flowing artesian well has been the result of the enterprise. A water of a slightly sulphurous odor rises smoothly and steadily in the six-inch tube.

In regard to the position of the well, its mouth is 840 feet above the level of the sea, this computation being based on the surveys of the Gulf Railroad Company. The well is bored upon the first bench on the south side of the Marmaton river, at the foot of the bluff, and 550 feet from the channel. The mouth of the well is 100 feet lower than the plateau. Above the mouth of the well is the bluff, consisting of limestone, hydraulic cement rock, coal, fire clay, and bituminous shale.

The diameter of the well is eight inches down to 335 feet, to which point the well was tubed with iron pipe to shut off the surface-water. Below that point the well was bored dry 45 feet to a depth of 380 feet, at which point the drill struck a 14-inch crevice and salt water rose to within 10 feet of the surface.

The boring was continued to a depth of 610 feet, when a different kind of water was reached, which began to flow slowly from the well. At a depth of 621 feet, the boring

\* Among the most extensive and reliable of all color-blind tests are those recently carried on by our own countryman, Dr. B. Joy Jefferies, who has tested 19,101 men, of whom 801 (4.18 per cent.) were color-blind; and 14,731 women, among whom he found but 11 cases. Other observers give averages varying from 1 per cent. to 8 per cent.

† Paper read before Section B, of the American Association for the Advancement of Science, Philadelphia, September 5, 1884.